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(54) Ultrasonic dissector

(57) An ultrasonic surgical instrument for dissection and coagulation of tissue is provided. The surgical instrument includes a vibration coupler supported within a housing and operably connected to an ultrasonic generator. An angled blade member is connected to the distal end of the vibration coupler to conduct high frequency vibration from the ultrasonic generator to the blade member. A clamp member is positioned adjacent to the blade member and is movable from a first position to a second approximated position. The clamp member and angled blade member combine to enhance contact between the tissue and the blade member during operation of the instrument to improve the performance of the instrument.

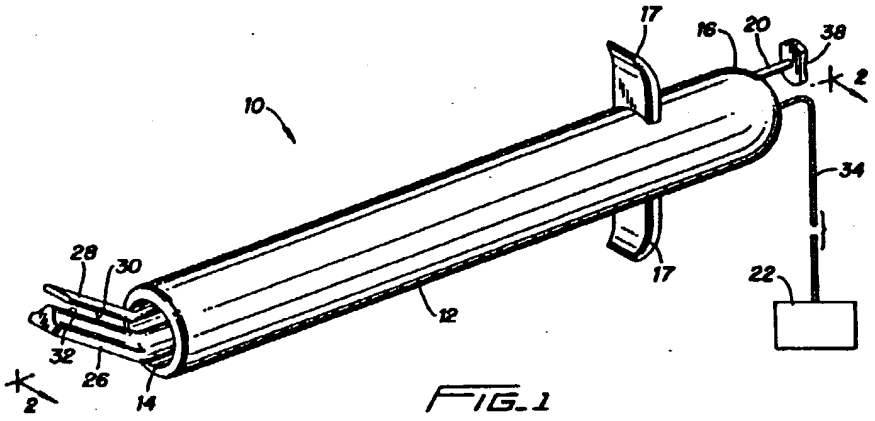

FIG. 1

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Description

BACKGROUND

1. Technical Field

The present disclosure relates to an ultrasonic instrument for surgical use. More specifically, the present disclosure relates to an ultrasonic instrument having an angled blade member and a clamp member particularly suited for use in performing dissection and coagulation of tissue.

2. Background of Related Art

Ultrasonic instruments for surgical use and the benefits associated therewith are well known. For example, the use of an ultrasonic generator in conjunction with a surgical scalpel facilitates faster and easier cutting of organic tissue and accelerates blood vessel clotting in the area of the cut, i.e., accelerated coagulation. Improved cutting results from increased body tissue to scalpel contact caused by the high frequency of vibration of the scalpel blade with respect to body tissue. Improved coagulation results from heat generated by contact between the scalpel blade and the body tissue as the scalpel blade is vibrated at a high frequency. Thus, in order to reap the advantages associated with ultrasonic energy, good blade to tissue contact is important.

U.S. Patent No. 3,862,630 ("Balamuth") discloses an ultrasonic system including an ultrasonic motor, a tool member having a working surface oriented normal to the direction of mechanical vibration generated by the ultrasonic motor, and a clamp member extending parallel to the tool member for compressing tissue against the tool member. U.S. Patent No. 5,322,055 ("Davison") discloses an ultrasonic surgical instrument adapted for endoscopic use having a blade and a clamp movable in relation to the blade to capture tissue therebetween. The blade and the clamp define a clamping region having a plane which is parallel to the longitudinal axis of the surgical instrument. During an endoscopic procedure, movement of the instrument is limited to movement along an axis parallel to the plane of the clamping region. Thus, no additional blade force is imposed on the body tissue as a result of movement of the instrument.

Accordingly, a need exists for an improved ultrasonic surgical instrument which is easy to use and provides fast and easy cutting and improved coagulation.

SUMMARY

In accordance with the present disclosure, an ultrasonic surgical instrument is provided for dissection and coagulation of tissue. The surgical instrument includes a housing and a vibration coupler supported within the housing operably connected to an ultrasonic generator. An angled blade member is connected to the distal end of the vibration coupler to conduct high frequency vibration to the blade member. A clamp member may be positioned adjacent to the blade member and is movable from a first position to a second approximated position to capture tissue therebetween. The clamp member and angled blade member combine to enhance contact between the tissue and the blade member during operation of the instrument to improve the performance of the instrument.

BRIEF DESCRIPTION OF THE DRAWINGS

Various preferred embodiments are described herein with reference to the drawings, wherein:

FIG. 1 is a perspective view of one embodiment of the ultrasonic instrument;
FIG. 2 is a side partial cross-sectional view of the ultrasonic instrument shown in FIG. 1;
FIG. 2A is a side partial cross-sectional view of the proximal end of the ultrasonic instrument shown in FIG. 1 with the actuation rod biased to its distalmost position;
FIG. 2B is a side partial cross-sectional view of the proximal end of the ultrasonic instrument shown in FIG. 1 further including a biasing and retaining mechanism wherein the actuation rod is retained in a retracted position;
FIG. 2C is a side partial cross-sectional view of the clamp member and blade member of the ultrasonic instrument shown in FIG. 1 in the open position;
FIG. 2D is a side partial cross-sectional view of the clamp member and the blade member of the ultrasonic instrument shown in FIG. 1 in the closed position;
FIG. 3 is a cross-sectional view taken along section line 3-3 of FIG. 2;
FIG. 4 is a cross-sectional view taken along section line 4-4 of FIG. 2C;
FIG. 4A is a cross-sectional view taken along section line 4A-4A of FIG. 2D;
FIG. 5 is a side partial cross-sectional view of an alternate embodiment of the ultrasonic instrument;
FIG. 6 is a side partial cross-sectional view of the blade member and clamp member shown in FIG. 5 with the clamp member in the open position; and
FIG. 6A is a partial side cross-sectional view of the blade member and the clamp member shown in FIG. 5 in the closed position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the presently disclosed ultrasonic dissector will now be described in detail with reference to the drawings, in which like reference

numerals designate identical or corresponding elements in each of the several views.

FIGS. 1-3 illustrate one embodiment of the presently disclosed ultrasonic instrument shown generally as 10. Briefly, ultrasonic instrument 10 includes a substantially cylindrical outer housing 12, preferably formed from molded housing half-sections, having an open distal end 14 and a closed proximal end 16. The housing 12 may be formed with a gripping member 17. The proximal end 16 of housing 12 is formed with a slot 18 dimensioned to slidably receive an actuation rod 20 which will be discussed in further detail below. A remotely located ultrasonic generator 22 is electrically connected to a transducer 23 via conventional means, such as a power cable 34. The transducer 23 is supported within the housing and engages a vibrator coupler 24 which extends longitudinally towards the distal end 14 of housing 12. A blade member 26 having a cutting edge 32 is provided at the distal end of the vibration coupler 24. The blade member 26 is fixedly connected to the vibration coupler 24 or alternately integral therewith, such that the cutting edge 32 defines a plane oriented at an acute fixed angle, preferably from about 30 degrees to about 70 degrees, with respect to the longitudinal axis of the instrument.

Ultrasonic generator 22 provides electrical energy having ultrasonic frequency to the transducer 23 to cause oscillation of the transducer 23 in a known manner. The transducer 23, which may be one of a variety of electromechanical types, e.g., electrodynamic, piezoelectric, magnetostrictive, is connected in end-to-end relation to the vibration coupler 24 to cause oscillation of the vibration coupler and corresponding oscillation of angled blade member 26.

Actuation rod 20 is movably supported within housing 12 and extends from the proximal end of housing 12, via slot 18, through the open distal end 14 of housing 12. Preferably, rod 20 is supported by brackets 36 which may be integrally formed with housing 12, although any conventional support structure which allows for linear movement of the actuation rod may be used. A proximal engagement surface 38 located externally of the housing 12 facilitates selective advancement of the actuation rod 20. Clamp 28 is connected to the distal end of the actuation rod 20 and includes clamp surface 30 which is substantially parallel to and faces cutting edge 32 of blade member 26. The clamp 28 is movable with respect to the blade member 26 from an open position to a closed position to capture tissue between the cutting edge 32 and the clamp surface 30. The clamp 28 may alternately be formed integral with the actuation rod 20 and may have a smooth texture although a knurled or ribbed surface may be provided to facilitate grasping of tissue or to enhance coagulation.

Referring to FIGS. 2A-2B, a biasing mechanism may be provided to bias the actuation rod 20 to a distal position and thus bias clamp 28 to the closed position. The biasing mechanism includes an annular ring 31 secured to or formed integrally with the actuation rod 20 and a biasing spring 33. Biasing spring 33 is positioned about the actuation rod 20 between bracket 36 formed on housing 12 and annular ring 31 to continuously urge the actuation rod 20 distally. (See FIG. 2A.) A retaining member 35 is pivotally secured within a slot 37 formed in the housing and is pivotable into engagement with a rack 39 formed on the actuation rod 20. The retaining member 35 can be pivoted in the counterclockwise direction by moving slide member 41 proximally, as viewed in FIG. 2B, to selectively retain the clamp 28 at various locations between the open and closed positions. The slide member 41 may be moved distally to disengage retaining member 35 from rack 37, as illustrated in FIG. 2A, to clamp tissue 50 between the clamp surface 30 and the cutting edge 32.

In use, the ultrasonic instrument 10 is grasped about the proximal end of housing 12 and moved to position the cutting edge 32 adjacent tissue to be dissected and/or coagulated. The actuation rod 20 is retracted against the bias of spring 33 by pulling the engagement surface 38 of actuation rod 20 to retract clamp 28 away from blade 26 and provide access for tissue. In the open position, the clamp 28 is spaced from the blade member 26 a distance to permit easy tissue access. (See FIG. 2C and 4.) When tissue 50 is positioned between clamp 28 and blade 26, engagement surface 38 is released to allow biasing spring 33 to move clamp 28 to the closed position and to capture tissue 50 therebetween. (See FIGS. 2D and 4A.) The actuation rod 20 may be retained in the retracted position while the instrument 10 is positioned about tissue by pivoting retaining member 35 counter-clockwise into engagement with rack 39 formed on actuation rod 20. (See FIG. 2B.) Clearly, other means to retain actuation rod 20 can be utilized. The ultrasonic generator 22 is energized to cause linear oscillation of the blade 26 with respect to the clamp 28 to effect dissection and/or coagulation of tissue 50. Alternately, the actuation rod 20 may be biased proximally to the open position so the clamp is biased to the open position. In this alternate embodiment, a retaining means can be utilized to retain the clamp in the closed position.

FIGS. 5-6A illustrate a further embodiment of the presently disclosed ultrasonic dissector shown generally as 100. Ultrasonic dissector 100 is provided with a pivotable clamp 128. Briefly, ultrasonic dissector 100 includes a transducer 123 supported within a housing 112 and adapted to be connected to an ultrasonic generator 122 via power cable 134. The transducer 123 engages a vibration coupler 124 having a blade member 126 rigidly attached, or alternatively integral, to the distal end of the coupler 124 therewith.

A clamp 128 is pivotably mounted to the distal end of housing 112 about pivot member 119 such that clamp 128 extends through an open distal end 114 of housing 112. Actuation rod 120 is supported on brackets 136 for linear movement within housing 112. The distal end 121

of actuation rod 120 is connected to a proximal end of clamp 128 via pin 117 to translate linear advancement of the actuation rod 120 to clockwise rotation of clamp 128.

A thumb actuation member 138 is fixedly connected to actuation rod 120 by a link 143. The link 143 extends through slot 145 formed in housing 112 to facilitate linear advancement of the thumb actuation member 138 and corresponding linear advancement of the actuation rod 120. A biasing mechanism for biasing the actuation rod to a proximal position and a retaining mechanism to retain the actuation rod 120 in a distal position is shown in FIG. 5. Alternately, as discussed with respect to FIG. 2, the actuation rod 120 may be biased distally to maintain clamp member 128 in the closed position. In this alternate embodiment, a retaining member can be utilized to retain the clamp in the open position.

More specifically referring to FIGS. 5-6B, clamp member 128 of ultrasonic instrument 100 is biased to the open position by biasing spring 133, which engages annular ring 131 to urge actuation rod 120 proximally. After the instrument 100 is properly positioned about tissue, actuation rod 120 may be advanced distally against the bias of spring 133, via actuation member 138, to pivot the clamp member 128 into substantial alignment with blade member 126 and capture tissue between clamp surface 130 and cutting edge 132. (See FIG. 6A.) The retaining member 135 may be pivoted clockwise to retain the clamp member 128 and blade member 126 in the closed position. Clearly, other means to retain the clamp member 128 in the closed position can be utilized. After tissue is captured between the clamp member and the blade member, the ultrasonic generator 122 may be actuated to effect dissection and/or coagulation of body tissue. As illustrated in FIG. 6A, the instrument may be moved proximally, during operation of the instrument, as indicated by arrow "B", to increase the force applied by the cutting edge 132 on body tissue 150.

It will be understood that various modifications may be made to the embodiments disclosed herein. For example, different handle assemblies may be provided on the proximal end of the instrument to improve gripping of the instrument, e.g., pistol grip. Also, the clamp member may be biased to the open or closed position. The claims which follow identify embodiments of the invention additional to those described in detail above.

Claims

1. A surgical cutting instrument comprising:

   (a) a vibration coupler connectable to an ultrasonic generator and defining a longitudinal axis; and

   (b) a blade member positioned adjacent a distal end portion of the vibration coupler and adapted to vibrate with the vibration coupler, the blade member having a planar cutting surface disposed at an acute angle to the longitudinal axis during vibration of the vibration coupler.

2. A surgical cutting instrument according to Claim 1, further comprising a clamp positioned adjacent the blade member, the clamp having a tissue engaging surface movable between an open position spaced from the planar cutting surface of the blade member and a clamped position wherein the tissue engaging surface is moved towards the planar cutting surface.

3. A surgical instrument according to any of the preceding claims, further including an actuation rod operably connected to the clamp, the actuation rod being movable to move the clamp between the first and second positions.

4. A surgical instrument according to any of the preceding claims, wherein the clamp is moved linearly from the open to the clamped position.

5. A surgical instrument according to any of the preceding claims, wherein the clamp is pivoted from the open position to the clamped position.

6. A surgical instrument according to any of the preceding claims, further comprising a biasing mechanism for biasing the clamp member with respect to the blade member.

7. A surgical instrument according to any of the preceding claims, further including a retaining mechanism to selectively retain the clamp at multiple locations between the first and clamped positions.

8. A surgical instrument according to any of the preceding claims, wherein the retaining mechanism includes a rack positioned on the actuation rod and wherein the retaining mechanism further includes a retaining member movable into operable engagement with the rack to retain the clamp in multiple locations between the open and clamped positions.

9. A surgical instrument according to any of the preceding claims, further including a housing, wherein the clamp is pivotably secured to the housing.

10. A surgical instrument according to any of the preceding claims, wherein the angle of the plane defined by the cutting surface of the blade member is from about 30 degrees to about 70 degrees.

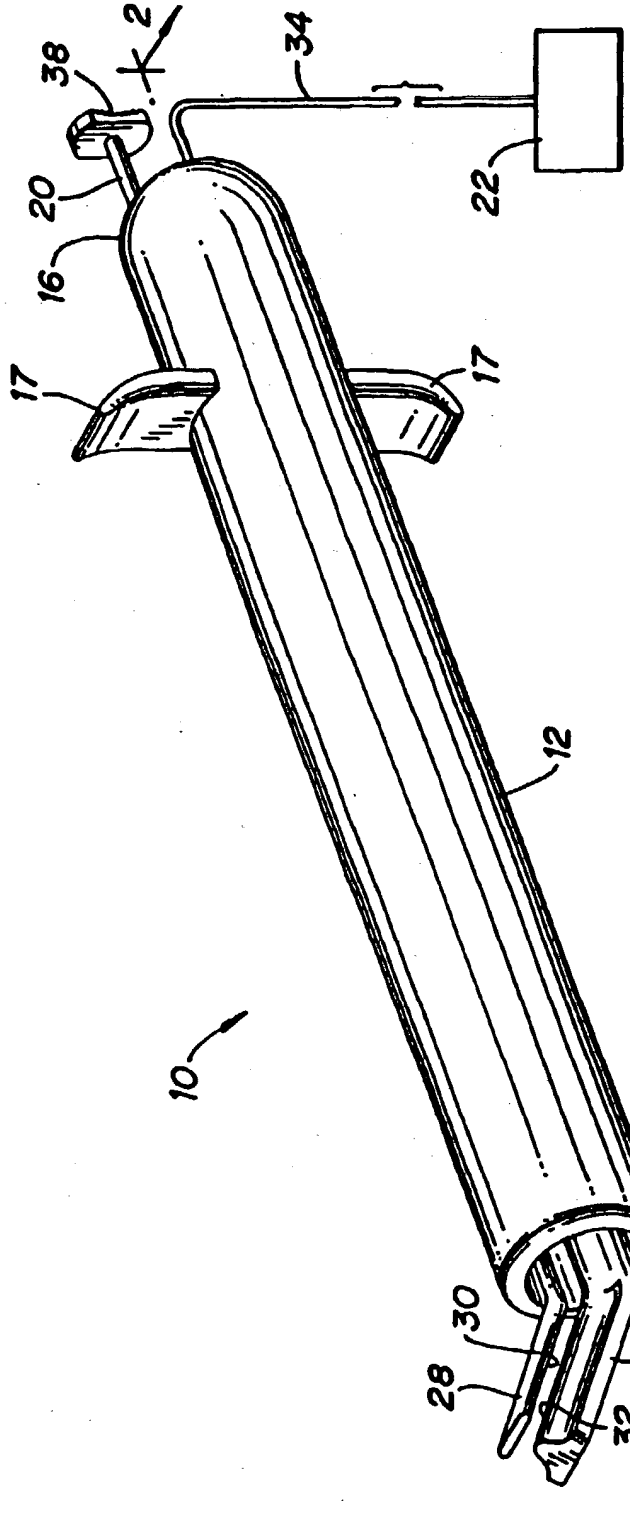


FIG_1

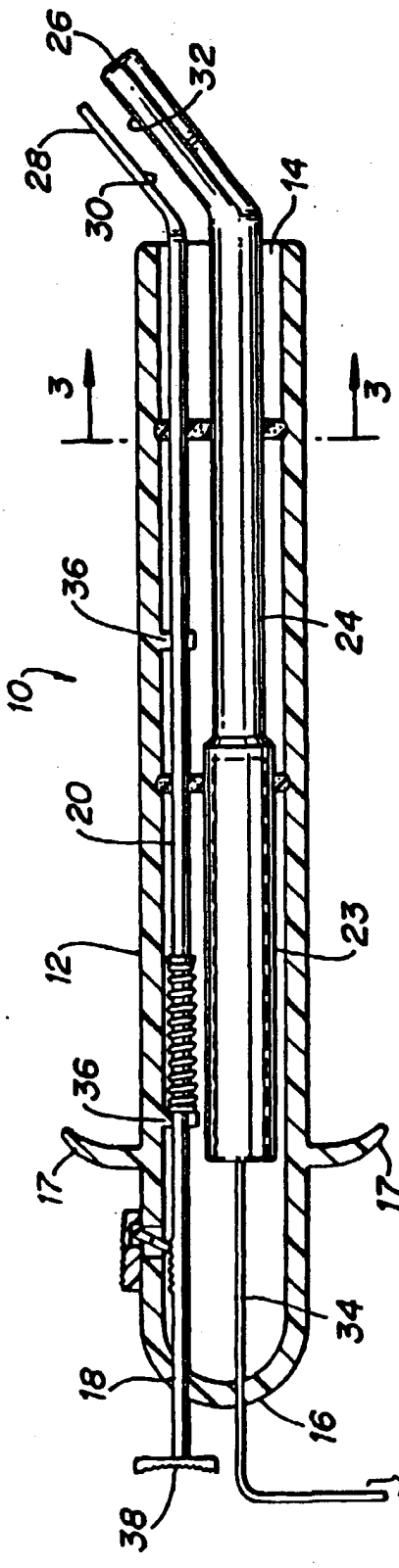


FIG. 2

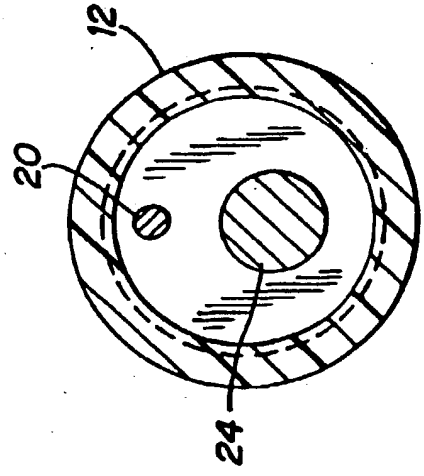


FIG. 3

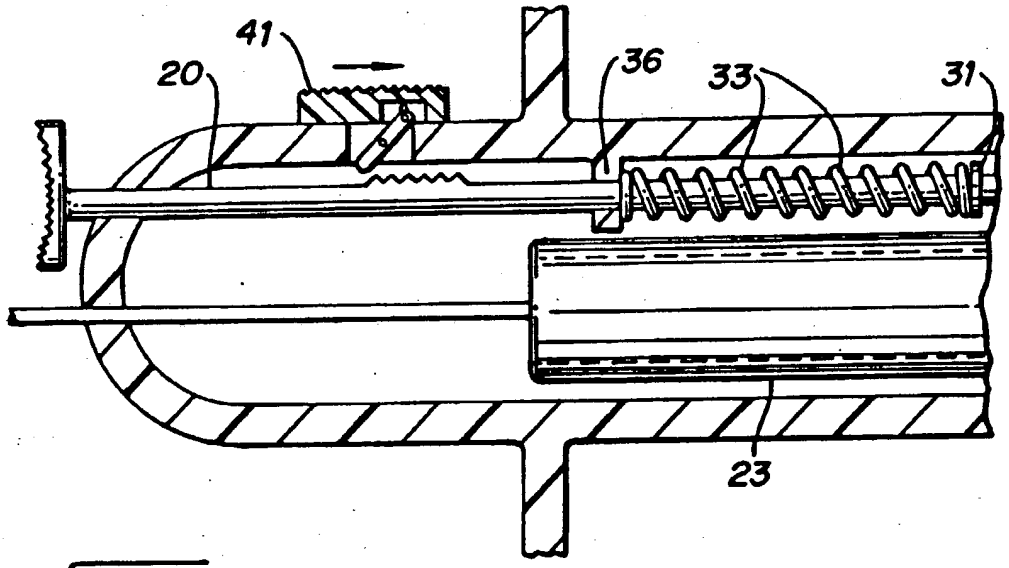


FIG. 2A

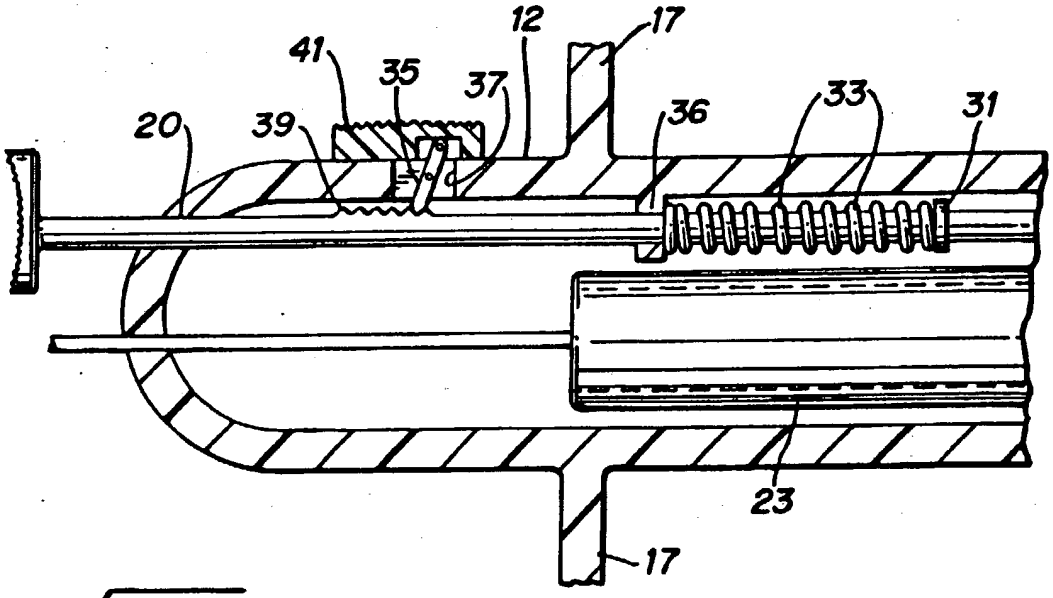


FIG. 2B

FIG. 2C

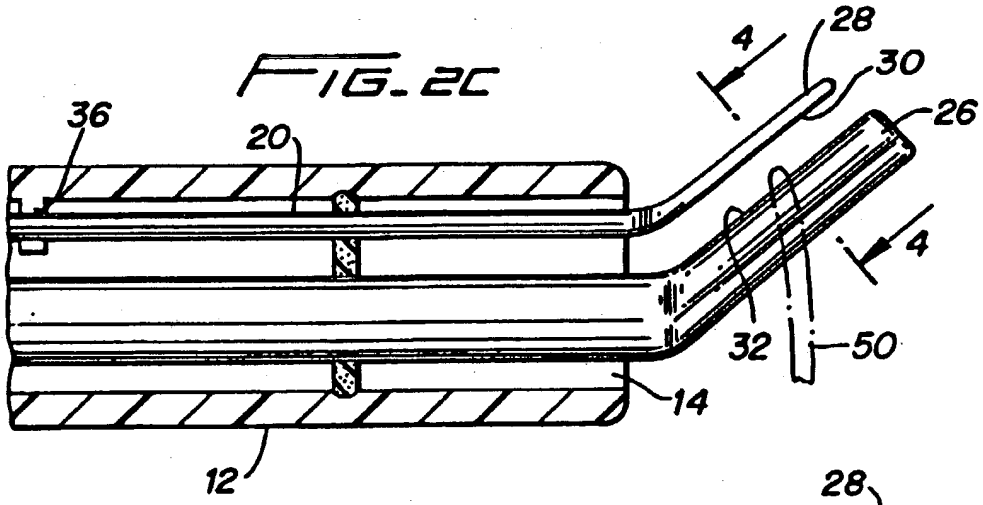


FIG. 4

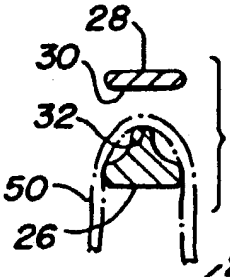


FIG. 2D

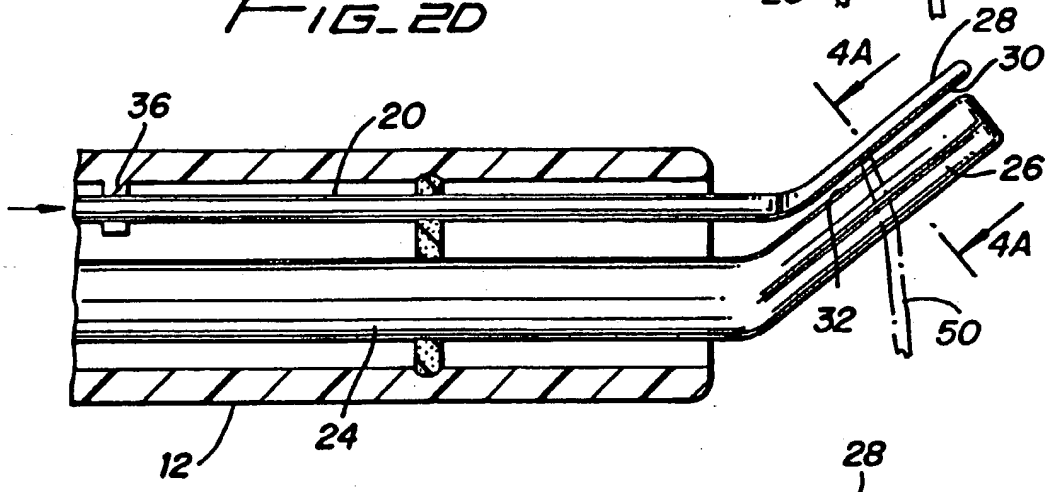
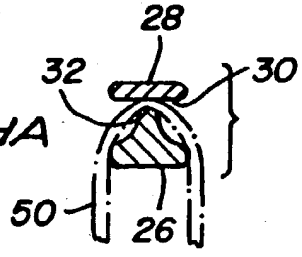


FIG. 4A



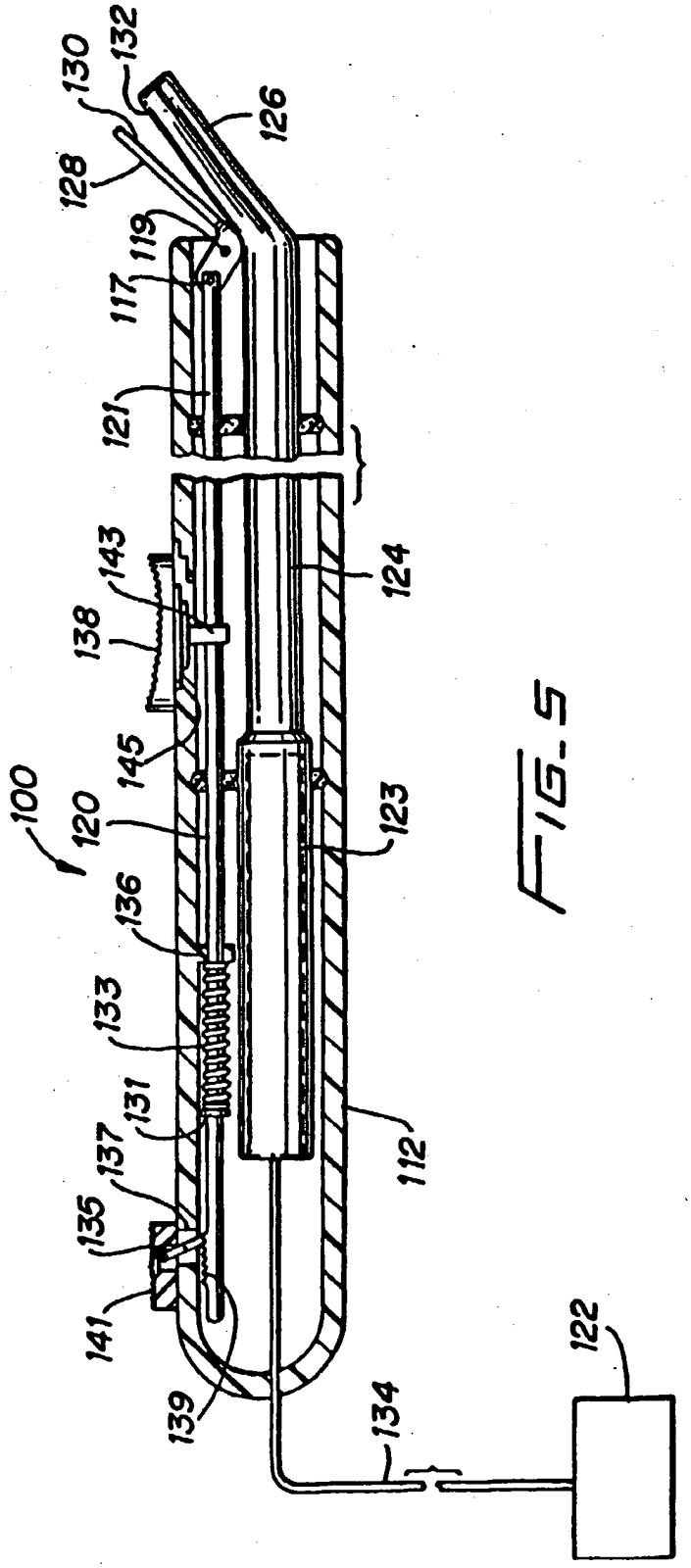

100
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FIG. 5

FIG. 6

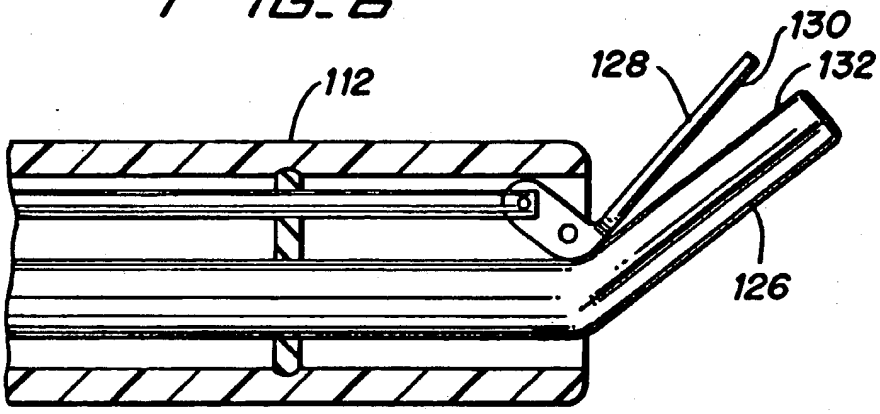
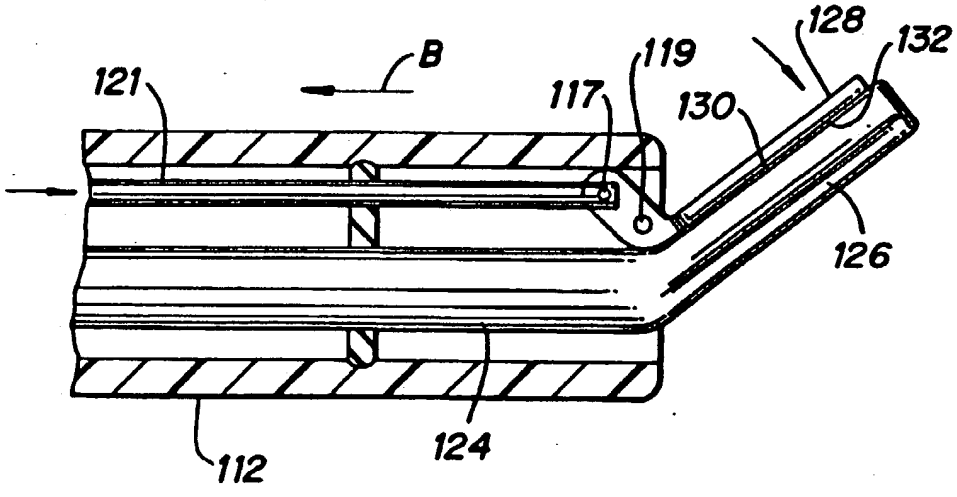


FIG. 6A



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 11 5935

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	EP 0 456 470 A (SUMITOMO) * column 4, line 3 - line 7; figures 5,8 *	1,10 2-9	A61B17/32 A61B17/22
X	US 5 263 957 A (DAVISON) * column 7, line 38 - line 50; figures 4,5 *	1,10	
X	WO 86 02257 A (COOPERVISION) * page 4, line 14 - page 6, line 10; figures 1-4 *	1,10	
Y,D	US 5 322 055 A (DAVISON ET AL.) * column 13, line 20 - line 28; claim 1; figures 3,8P,Q *	2-9	
A,D	US 3 862 630 A (BALAMUTH) * column 14, line 15 - column 15, line 6; figures 10,11 *	4,6	
A	WO 94 20025 A (MICROSURGE INC) * page 21, line 2 - page 23, line 9; figure 9 *	7,8	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A61B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 January 1998	Moers, R

CATEGORY OF CITED DOCUMENTS

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